U. S. FOREST SERVICE

RESEARCH NOTE NC-35

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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WINTER THAWS CAN RAISE GROUND WATER LEVELS IN DRIFTLESS AREA[1]

ABSTRACT. — Springflow and ground water levels both rose with winter thaws, even when the ground was frozen. A high soil water content suggests that water moved to the water table through a continuous column of soil water rather than as a wetting front.

Winter or early spring thaws occur frequently in the lower Lake States region. They may last for one or more days and are usually followed by an extended period of freezing before the normal springtime thaw. Since the ground is generally frozen at the time, they may produce snowmelt runoff. Sometimes they even cause an out-of-season flood.

Recent springflow studies on the Coulee Experimental Forest in southwestern Wisconsin show that winter thaws can also help recharge the ground water system, even during a period of deep soil frost. Three late winter thaws in 1965 produced sharp rises in springflow and corresponding rises in the water table above the spring (fig. 1). The spring, which had flowed continuously during a 5-year period of record, dried up in November 1964. It remained dry until February 6, when a 3-day thaw produced the rise shown. A 1-day thaw on February 20 produced a smaller rise; and then a third thaw that began on February 27 and lasted for 10 days produced another larger rise. Thereafter, flow receded normally until the regular springtime rise began on March 31.

The increases in flow were roughly proportional to the amounts of heat during the respective thaw periods. Expressed as degree-hours above 32° F., the values were: 340 (February 4 to 7), 110 (February 20), and 950 (February 27 to March 8). The repeated thaws prevented accumulation of a continuous snowpack, and there was never much snow on the ground at one time. Had a deeper snowpack existed, the same thaws might not have released meltwater, since more heat would have been needed to "ripen" the snowpack.

Water table changes, measured at a well 500 feet from the springhead, show that the ground water table responded rapidly to relatively small amounts of melting snow. The water level during the period was about 50 feet below the ground surface. Flumes on the Experimental Forest recorded surface flow during the thaws; so we know that the melting snow produced water at the ground surface. We infer from the marked springflow rises that this resulted in infiltration as well as surface flow. The almost instantaneous response suggests that the infiltrating water recharged the water table through a continuous capillary column rather than a wetting front. Soil water measurements tend to

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[1] *This work was done at the Station's field office in La Crosse, Wis., where research in runoff and erosion reduction is done in cooperation with the Wisconsin Conservation Department.*

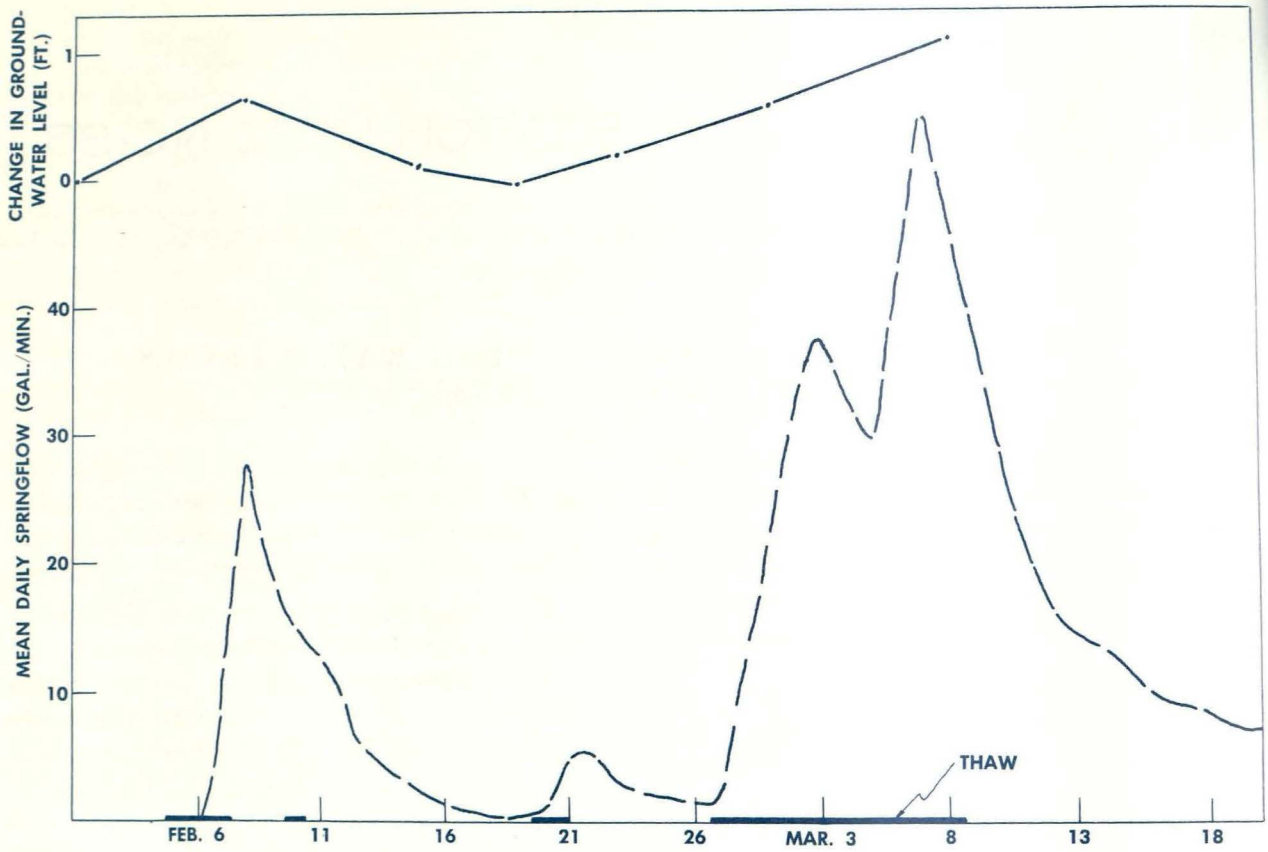

Figure 1.—Effect of winter thaws on springflow and ground water levels, 1965. The plotted points of the upper chart show the dates when well depth was measured. Minor changes probably occurred between these dates.

support this. Water content in a 5-foot profile (determined from periodic readings with a neutron meter) near the spring averaged about 38 percent by volume (Pv.), with less than one Pv. variation during the period. This approximates field capacity for the loessal silt loam soils of the Experimental Forest.

Schneider[2] ascribed the rise of water tables following winter thaws to percolation of soil water from a thawing frost layer, rather than to infiltration. However, frost measurements on open land (alfalfa meadow, southeast slope) taken concurrently with this study showed that the thaws did not affect the thickness of the frozen layer. Frost depth ranged from 2.0 to 2.6 feet. On the wooded north slope above the spring, however, frost depth averaged one-half foot on February 15, with 90 percent of sample points falling on frozen ground. This is a relatively thick frozen layer for forest soils, which normally have much less frost than open-land soils. Most of the watershed is forested; so most of the water must have come from forest land. Was the 10 percent of unfrozen ground the major source of infiltration, or was the frozen ground also permeable enough to take in water from slowly melting snow? We hope to find out from planned studies.

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[2] *Schneider, Robert. Correlation of ground water levels and air temperatures in the winter and spring in Minnesota. U.S. Geol. Surv. Water-Supply Pap. 1539-D, 14 pp., illus. 1961.*